



## OFFICIAL STUDY GUIDE 2001 EDITION



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**COLLEGE-LEVEL EXAMINATION PROGRAM**

# General Biology

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## Description of the Examination

The Subject Examination in General Biology covers material that is usually taught in a one-year biology course at the college level. The subject matter tested covers the broad field of the biological sciences, organized into three major areas: molecular and cellular biology, organismal biology, and population biology. The exam gives approximately equal weight to these three areas, and the questions relating to them are interspersed randomly throughout the exam.

The exam consists of approximately 120 multiple-choice questions to be answered in two separately timed 45-minute sections.

## Knowledge and Skills Required

Questions on the exam require candidates to demonstrate one or more of the following abilities.

- Knowledge of facts, principles, and processes of biology
- Understanding of the means by which information is collected and how it is interpreted
- Understanding of how one hypothesizes from available information and how one draws conclusions and makes further predictions
- Understanding that science is a human endeavor with social consequences

The subject matter of the General Biology exam is drawn from the following topics.

➡ <i>Approximate Percent of Examination</i>	
33%	Molecular and Cellular Biology <ul style="list-style-type: none"><li>Chemical composition of organisms</li><li>Simple chemical reactions and bonds</li><li>Properties of water</li><li>Chemical structure of carbohydrates, lipids, proteins, organic acids, nucleic acids</li></ul>

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➡ *Approximate Percent of Examination*

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Cells

Structure and function of cell organelles

Properties of cell membranes

Comparison of prokaryotic and eukaryotic cells

Enzymes

Enzyme-substrate complex

Role of coenzymes

Inorganic cofactors

Prosthetic groups

Energy transformations

Glycolysis, respiration, anaerobic pathways

Photosynthesis

Cell division

Structure of chromosomes

Mitosis, meiosis, and cytokinesis in plants and animals

Chemical nature of the gene

Watson-Crick model of nucleic acids

DNA replication

Mutations

Control of protein synthesis: transcription, translation,  
post-transcriptional processing

Structural and regulatory genes

Transformation and transduction

The origin of life

Modern theories

Experimental evidence

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➡ *Approximate Percent of Examination*

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34% Organismal Biology

Structure and function in plants with emphasis on angiosperms

Root, stem, leaf, flower, seed, fruit

Water and mineral absorption and transport

Food translocation and storage

Plant reproduction and development

Alternation of generations in ferns, pines, and flowering plants

Gamete formation and fertilization

Growth and development: hormonal control

Tropism and photoperiodicity

Structure and function in animals with emphasis on vertebrates

Major systems

Homeostatic mechanisms

Hormonal control in homeostasis and reproduction

Animal reproduction and development

Gamete formation, fertilization

Cleavage, gastrulation, germ layer formation, differentiation of organ systems

Experimental analysis of vertebrate development

Extraembryonic membranes of vertebrates

Formation and function of the mammalian placenta

Blood circulation in the human embryo

Principles of heredity

History of early experiments in heredity

Mendelian inheritance (dominance, segregation, independent assortment)

Chromosomal basis of inheritance

Linkage

Sex-linked, sex-influenced, sex-limited inheritance

Polygenic inheritance (height, skin color)

Multiple alleles (human blood groups)

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➡ *Approximate Percent of Examination*

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33%	Population Biology
	Principles of ecology
	Energy flow and productivity in ecosystems
	Biogeochemical cycles
	Population growth and regulation (natality, mortality, competition, migration, density)
	Community structure, growth, regulation (major biomes, succession and climax communities)
	Habitat (biotic and abiotic factors)
	Concept of niche
	Principles of evolution
	History of evolutionary concepts, Lamarckian and Darwinian theories
	Modern concepts of natural selection (differential reproduction, mutation, Hardy-Weinberg equilibrium, speciation)
	Adaptive radiation
	Major features of plant and animal evolution
	Concepts of homology and analogy
	Convergence, extinction, balanced polymorphism, genetic drift
	Classification of living organisms
	Evolutionary history of humans
	Principles of behavior
	Stereotyped, learned social behavior
	Societies (ants, bees, birds, primates)
	Social biology
	Problem of human population growth (age composition, birth and fertility rates, theory of demographic transition)
	Human intervention in the natural world (management of resources, environmental pollution)
	Implications of biomedical progress (control of human reproduction, genetic engineering)

## Sample Questions

The 25 sample questions that follow are similar to questions on the General Biology exam, but they do not actually appear on the exam. CLEP exams are designed so that average students completing a course in the subject can usually answer about half the questions correctly.

Before attempting to answer the sample questions, read all the information about the General Biology exam given above. Additional suggestions for preparing for CLEP exams are provided in Chapter 1.

Try to answer correctly as many questions as possible. Then compare your answers with the correct answers, given at the end of this examination guide.

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

1. In which of the following ways do social insects benefit most from having several types or castes within the species?
  - (A) Each colony is able to include a large number of individuals.
  - (B) The secretions or odors produced by the protective caste are an effective defense.
  - (C) The division of the species into castes ensures the survival of the fittest.
  - (D) Large numbers of the worker caste can migrate to start new colonies.
  - (E) The specialized structure of each caste permits division of labor and greater efficiency.

(A) (B) (C) (D) (E)
  
2. The greatest diversity of structure and of methods of locomotion is exhibited in the individuals of
  - (A) a class
  - (B) a family
  - (C) an order
  - (D) a species
  - (E) a phylum

(A) (B) (C) (D) (E)

3. Of the following, which is an example of a mutualistic relationship?
- (A) The protozoan *Trichonympha* digesting wood in the gut of termites
  - (B) The sporozoan *Plasmodium* reproducing in human blood cells and liberating toxins into the human body
  - (C) Two species of *Paramecium* deriving food from a common laboratory culture
  - (D) Rabbits being eaten by foxes
  - (E) Humans inadvertently providing food for cockroaches
- (A) (B) (C) (D) (E)
4. Evidence that multicellular green plants may have evolved from green algae is supplied by the fact that in both
- (A) the gametophyte generation is dominant
  - (B) the sporophyte generation is dominant
  - (C) chlorophylls *a* and *b* are photosynthetic pigments
  - (D) xylem vessels are pitted and spiraled
  - (E) male gametes are nonflagellated
- (A) (B) (C) (D) (E)
5. All of the following statements concerning the light-dependent phase of photosynthesis are true EXCEPT
- (A) An initial event is the excitation of electrons from chlorophyll by light energy.
  - (B) The excited electrons are raised to a higher energy level.
  - (C) If not captured in the reaction, the excited electrons drop back to their initial energy levels.
  - (D) If captured in the reaction, some of the energy of the excited electrons is used to split carbon dioxide to carbon and oxygen.
  - (E) The reaction occurs in grana.
- (A) (B) (C) (D) (E)

6. Which of the following statements best explains the hypothesis that the development of sexual reproduction has resulted in acceleration of the rate of evolution?
- (A) Mutations are more likely to occur in spermatogenesis and oogenesis than in mitotically dividing cells.
  - (B) Sexual reproduction results in more offspring than does asexual reproduction.
  - (C) Those members of a species that are best adapted to their environment are most likely to be successful in sexual reproduction.
  - (D) Mutations usually do not occur in the production of spores or in cells dividing by fission.
  - (E) Sexual reproduction is more likely to result in genetic recombination than is asexual reproduction.

(A) (B) (C) (D) (E)

A frog gastrocnemius muscle gives a smooth tetanic contraction at any rate of stimulation above 20 per second. At threshold stimulus intensity, a response of some specific strength will be obtained. Increase of the stimulus intensity by 50 percent will increase the strength of response nearly 50 percent. If the intensity is again increased 50 percent, the response will increase only about another 25 percent. Further increase in the stimulus intensity produces no further increase in response.

7. The observations above are best explained by which of the following?
- (A) A muscle functions with an all-or-none mechanism.
  - (B) Muscle-fiber sarcolemma is electrically resistant.
  - (C) The fibers of a muscle do not all contract at the same rate.
  - (D) The fibers of a muscle fatigue at varying rates.
  - (E) The fibers of a muscle have varying thresholds for response.

(A) (B) (C) (D) (E)

8. In an amphibian gastrula, transplantation experiments that involve the dorsal lip of the blastopore indicate that this tissue
- (A) is destined to be ectoderm
  - (B) does not differ from other tissues of the blastula in any significant manner
  - (C) will cause a concentration of yolk in adjacent cells
  - (D) has the power to initiate differentiation of the embryonic neural tube
  - (E) is so sensitive that it will develop into any embryonic structure depending on its surroundings
- (A) (B) (C) (D) (E)
9. Deposits of coal in Greenland and the Antarctic indicate that
- (A) these regions once contained numerous mollusks that deposited carbohydrates in their shells
  - (B) the Earth's crust in these regions contains vast amounts of limestone
  - (C) these regions were once thickly vegetated
  - (D) there is a rich store of dissolved carbon dioxide in the seas surrounding these regions
  - (E) a geologic uplift of coral rock and ocean bed has recently occurred in these regions
- (A) (B) (C) (D) (E)
10. Thirst, loss of weight, and sugar in the urine result from the undersecretion of a hormone by which of the following?
- (A) Thyroid
  - (B) Parathyroids
  - (C) Islets of Langerhans
  - (D) Adrenals
  - (E) Thymus
- (A) (B) (C) (D) (E)
11. Considering the role of mitochondria in cells, one would expect to find mitochondria most abundant in which of the following?
- (A) Mature red blood cells
  - (B) Callous cells of the skin
  - (C) Cells of the heart muscle
  - (D) Epithelial cells of the cheek lining
  - (E) Fat cells
- (A) (B) (C) (D) (E)

12. All of the following statements about enzymes are true EXCEPT
- (A) A single enzyme molecule can be used over and over again.
  - (B) Most enzymes are highly specific with regard to the reactions they catalyze.
  - (C) Some enzymes contain an essential nonprotein component.
  - (D) Enzymes can function only within living cells.
  - (E) Enzymes are destroyed by high temperatures.
- (A) (B) (C) (D) (E)
13. Which of the following factors figures most significantly in limiting the size to which an animal cell may grow?
- (A) The ratio of cell surface to cell volume
  - (B) The abundance of mitochondria in the cytoplasm
  - (C) The chemical composition of the cell membrane
  - (D) The presence of an inelastic cell wall
  - (E) The relative number of nucleoli
- (A) (B) (C) (D) (E)
14. Which of the following best describes the effect on heart action of the stimulation of the parasympathetic nerve fibers of the vagus nerve?
- (A) There is a decrease in the volume of blood pumped and an increase in the heartbeat rate.
  - (B) There is an increase in the volume of blood pumped without a decrease in the heartbeat rate.
  - (C) There is a prolonged acceleration in the heartbeat rate.
  - (D) There is a decrease in the heartbeat rate.
  - (E) There is an initial increase in the heartbeat rate, followed by a decrease.
- (A) (B) (C) (D) (E)
15. If poorly drained soils encourage the growth of bacteria that convert nitrate to nitrogen, the effect on higher plants will be to
- (A) increase lipid production
  - (B) decrease protein production
  - (C) increase carbohydrate production
  - (D) produce unusually large fruits
  - (E) stimulate chlorophyll production
- (A) (B) (C) (D) (E)

16. A patient is placed on a restricted diet of water, pure cooked starch, olive oil, adequate minerals, and vitamins. If a urinalysis several weeks later reveals the presence of relatively normal amounts of urea, the urea probably came from the

- (A) food eaten during the restricted diet
- (B) withdrawal of reserve urea stored in the liver
- (C) chemical combination of water, carbon dioxide, and free nitrogen
- (D) deamination of cellular proteins
- (E) urea synthesized by kidney tubule cells

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

**Directions:** The following group of questions consists of five lettered headings followed by a list of numbered phrases. For each numbered phrase select the one heading that is most closely related to it. A heading may be used once, more than once, or not at all.

**Questions 17-19**

- (A) Fertilization
- (B) Meiosis
- (C) Mitosis
- (D) Pollination
- (E) Nondisjunction

17. The process by which a zygote is formed

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

18. The process by which somatic (body) cells divide

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

19. The process by which monoploid (haploid) cells are formed from diploid cells

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

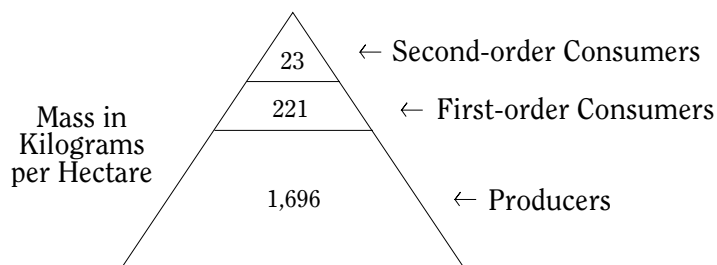
**Directions:** Each group of questions below concerns an experimental situation. In each case, first study the description of the situation. Then choose the best answer to each question following it.

**Questions 20-22**

Expenditures of solar energy, calculated by C. Juday for Lake Mendota in southern Wisconsin, appear in the table below.

Reflected or otherwise lost .....	49.5%
Absorbed in evaporation of water .....	25.0%
Raising of temperatures in the lake .....	21.7%
Melting of ice in the spring .....	3.0%
Directly used by organisms .....	0.8%

The pyramid of biomass for this same lake is represented by the following diagram.



20. The most probable explanation for the relative masses of the first- and second-order consumers is that
- (A) each link in the food chain of an ecosystem has less available energy than the previous link has
  - (B) only a small fraction of sunlight that reaches the Earth is transformed into chemical energy by photosynthesis
  - (C) the total energy of the decomposers is greater than that of the rest of the organisms put together
  - (D) seasonal fluctuations in weather limit the number of consumers
  - (E) second-order consumers require more total energy than first-order consumers do

(A) (B) (C) (D) (E)

21. The energy incorporated into this ecosystem is most dependent on the
- (A) photoperiod
  - (B) total amount of photosynthesis
  - (C) predator-prey relationships
  - (D) length of the food chains
  - (E) total amount of respiration
- (A) (B) (C) (D) (E)
22. If the lake is assumed to be a typical ecosystem, the percent of radiant energy from the Sun that is trapped in photosynthesis is about
- (A) 100%
  - (B) 10%
  - (C) 1%
  - (D) 0.1%
  - (E) 0.01%
- (A) (B) (C) (D) (E)

**Questions 23-25**

Inheritance of certain characteristics of the fruit fly, *Drosophila*, is as indicated by the table below.

<u>Characteristic</u>	<u>Dominant</u>	<u>Recessive</u>
Body color .....	Gray	Black
Eye color .....	Red	White

A female fruit fly had a gray body and white eyes. After being mated with a male fruit fly, she laid 112 eggs that developed into the following kinds of offspring.

<u>Number</u>	<u>Body</u>	<u>Eyes</u>
28	Gray	Red
29	Gray	White
28	Black	Red
27	Black	White

23. With respect to body color, the male parent of the 112 offspring was most probably
- (A) homozygous gray
  - (B) heterozygous gray
  - (C) homozygous black
  - (D) heterozygous black
  - (E) of a genotype that cannot be determined from the data given
- (A) (B) (C) (D) (E)
24. Examination revealed that all of the 56 red-eyed offspring were females and all of the 56 white-eyed offspring were males. This observation indicates that
- (A) red and white eye colors segregate independently of sex
  - (B) all of the red-eyed offspring inherited their eye color from their female parent
  - (C) all of the red-eyed offspring were homozygous
  - (D) the gene for eye color is linked to the gene for body color
  - (E) the gene for red or for white eye color is carried on the X-chromosome
- (A) (B) (C) (D) (E)
25. In this experiment, the number of offspring that exhibit both recessive characters is
- (A) 1
  - (B) 27
  - (C) 28
  - (D) 55
  - (E) 56
- (A) (B) (C) (D) (E)

## Study Resources

Most textbooks used in college-level introductory biology courses cover the topics in the outline given earlier, but their approaches to certain topics and the emphases given to them may differ. To prepare for the General Biology exam, a candidate is advised to study one or more college textbooks, which can be found in most college bookstores. When selecting a textbook, check the table of contents against the “Knowledge and Skills Required” section on pages 1-4. In addition, candidates would do well to consult pertinent articles from the monthly magazine *Scientific American*, available in most libraries. The Internet is another resource the candidate could explore.

## ***Answers to Sample Questions***

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### **General Biology**

1. E
  2. E
  3. A
  4. C
  5. D
  6. E
  7. E
  8. D
  9. C
  10. C
  11. C
  12. D
  13. A
  14. D
  15. B
  16. D
  17. A
  18. C
  19. B
  20. A
  21. B
  22. C
  23. C
  24. E
  25. B
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